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Association between screen time and developmental screening test performance in children under the age of five

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ABSTRACT

Aims: Excessive screen time has been linked to delays in development, but it is not clear whether it predicts lower performance scores or affects challenging behavior in children. The study aims to evaluate the correlation between screen time and child development in children aged 6-60 months.

Methods: The study conducted in Turkiye, involving 230 mothers and children aged 0 and 60 months, assessed screen-time behavior and developmental outcomes using the questionnaire, and the Denver Developmental Screening Test-II (DDST-II).

Results: The DDST-II test of 155 (67.4%) of the children was evaluated as normal, 42 (18.2%) as abnormal, and 33 (14.6%) as uncertain. The mean age of those whose DDST-II was abnormal was 46±12.3 months. Children exposed to screens for over an hour had abnormal DDST-II results compared to those exposed for less than an hour More than 3 hours screen exposure were associated with a higher rate of abnormal DDST-II results DDST-II results were significantly associated with parental control over screen exposure.

Conclusion: A positive relationship between screen time and developmental delay in children, emphasizing the significance of effective family media strategies and screen control.

Keywords: Children, developmental delay, screen time, screen exposure

INTRODUCTION

Developmental delay (DD) is defined as disruptions in language, motor, social, and cognitive development, which affects 10-15% of all children worldwide.[1] Early detection and referring to pediatrics are essential. Developmental tests distinguish abnormal and normal children who achieve developmental abilities at a slower rate. They should be trustworthy, easy to use, specific, sensitive, and inexpensive.

Denver Developmental Screening Test-II (DDST-II) is a method to identify delays in development in children from birth to six years. It organized into four main groups: gross motor, fine motor-adaptive, language, and personal-social. The tool classifies children into three categories: normal, abnormal, and questionable. Adaptation and standardization on Turkish children were conducted by Anlar.[2] The tool has high test-retest reliability and a Cronbach's α coefficient of 0.95-0.96.[3]

Initial childhood experiences affect a child's developmental learning capacity. One in every four children shows DD by school age, causing inadequate preparation for learning and academic success. Factors like pre-term birth and low birth weight were generally associated with DD in previous researchs.[4]

There are several reports and findings about the effect of gender, race, geographic location, parental educational level on the DD in literature.[5] There is no consensus on the effectiveness of certain factors on DD, as they are found in various studies.[5]

Digital media exposure and screen time may exacerbate disparities in early child development and is rapidly changing as it becomes more accessible and consumed. Screening time guidelines from the pediatric groups and World Health Organization (WHO) recommend that preschoolers limit their screen time to one hour per day. However, only 15% of families meet these requirements.[6,7]

Infants are first exposed to mobile phones when their parents use video calling to connect with relatives. As parents watch

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television, babies are exposed to background television. Digital media devices are occasionally used by caregivers to help children relax. Today's children are growing up with technologies such as mobile and smart devices in both housing and educational conditions. The American Academy of Pediatrics (AAP), suggests that infants under the age of two not be exposed to media. Nevertheless, babies are frequently exposed to screens before the age of 12 months.[8]

A child's average per day exposure to screens raises significantly with age. Children aged 0 to 8 use multimedia devices for an average of two and a half hours per day. The majority of screen time is spent watching television or internet. Children's media usage time rose by 32% over the last two decades. Approximately 74% of families report that their children under two years watch television.[9]

Media-centric parents leads to children spending an average of 4.30 hours daily on screens. Media-moderate parents, regulates screen time and material use, and promotes outside and imaginative activities. Household income, education of parents, family environment, race, and ethnic background all have an impact on how much media children consume.[9]

Research suggests a negative link between infant screen exposure and child development.[10,11] Screen exposure in infants and preschool children has a negative impact on their overall wellness, development, concentration, sleeping, physical activity, communication, language skills, socio-emotional health, and behaviors, demonstrating a link between screen time and development of children.[11-15] Parents who frequently use smartphones and other devices without their children may have limited interaction time, potentially reducing their children's language development. Social interaction in childhood significantly impacts children's social competence. Moon et al.[16] found a negative correlation with expressive language months.

Exceeding screen time guidelines at two and tree years of age results in increased behavioral problems and DDs at three and five years. Pediatrics is studying whether there is a dose-response relationship between screen time and child outcomes, particularly in preschoolers.[11,17] Understanding the effects of screen exposure in infancy and toddlerhood can aid in the creation of successful public health measures for high-risk families.

We aim to investigate the the child and parent sociodemographic factors thought to contribute to early childhood DD, as well as the impact of screen exposure on a child's motor and language development between the ages of 6 and 60 months.

METHODS

The study was conducted in accordance with the Declaration of Helsinki. Ethics Committee Approval of the study was carried out with the permission of the Dışkapı Yıldırım Beyazıt Training and Research Hospital' Ethics Committee, (Date 25.11.2019 Decision No:76/03). The study included a community sample of mother-child pairs recruited during routine visits to Family Health Center between aged 6 to 60 months. We interviewed the 230 mothers face to face, using a questionnaire to collect descriptive data, socioeconomic demographic information, and parameters for screen exposure. The questionnaire has two parts: The first section discussed the characteristics of the children, such as gestational age, delivery method, gender, birth weight, and medical history. The second part discussed children's screen exposure characteristics, such as screen type, time, and parental control. Mothers reported that their children spent their usual days viewing television (TV), utilizing the phone and computer/i-pad. Following that, children's gross motor, fine motor-adaptive, language, and personal-social development were evaluated using the DDST-II. A physical therapist with at least three years of experience using the DDST-II made the tests. The standard test with, adapted for Turkish children, and was administered by the same child development-education specialist who was unaware of the cases' history and neurological examination. The abilities of the subjects with appropriate conditions (full and clean) in personal-social, fine motor, language and gross motor areas were measured. DDST-II organized into four main groups: gross motor, fine motor-adaptive, language, and personal-social. The tool classifies children into three categories: normal, suspect, and untested. The tool evaluates skills passed by 75% to 90% of children, with 'caution' labels for failures and 'delay' labels for not performing activities passed by 90%. When the subject receives one delay or two or more warns, outcome is regarded as questionable. If two or more delays occur, the outcome is regarded as abnormal. For the overall score, patient's outcomes in subgroups are evaluated using the same rule as normal, questionable, and abnormal.[2,3] Healthy infants with no background conditions or diagnosed DD at the time of recruitment were considered. Exclusion criteria included twins, and severe neurological conditions. Children with an elevated risk or diagnosis of DD (pre-term birth, required ventilation, were taken to the newborn intensive care unit and underlying medical issues (congenital, musculoskeletal, or neurological abnormalities) were excluded. Mothers reported their children's screen time on all days of the week, including television, computers, and I pads, gaming systems. Screen time evaluated in hours per day.
Children's gender, age, type of birth, birth weight, breastfeeding status and exclusive breastfeeding length, time to transition to supplementary food, use of ready-made food, iron and vitamin D replacement status, also presence of screen exposure, duration, reasons, screen type, and whether it was parent-controlled were all assessed. The relationship between all variables and the DDST-II test results was examined.

Statistical Analysis

Study data were analyzed using IBM SPSS statistics Version 23.0 (IBM Corporation, United States). The suitability of continuous variables to normal distribution was examined with the Kolmogorov-Smirnov test. Categorical variables in the study are presented with frequency and percentage, and continuous variables are presented with mean, standard deviation, minimum and maximum values. Mann Whitney U test, chi squared and Kruskal Wallis test was used to compare the groups. Statistical significance was set at p value <0.05.

RESULTS

The study included 230 children; with 130 (56.5%) of them females and 100 (43.5%) of them males, with a mean age of 34.83 ± 16.43 months (min 6, max 60). Demographic characteristics and medical history of children were in Table1. Mothers had a mean age of 31.61±5.81 years (min 19, max

Table1. Demographic and clinical characteristics of patients (n: 230)

		n	(%)
Female		130	56.5
Male		100	43.5
Age (years) (mean)		34.83±16.43 (min 6, max 60).	
Height	<3percentile	2	0.9
	3-97 percentile	219	95.2
	>97 percentile	9	3.9
Weight	<3percentile	5	2
	3-97 percentile	209	90.9
	>97 percentile	16	7
Birth time	Term	230	100.0
Type of birth	C/S	111	48.3
	Spontan vaginal	119	51.7
Birth weight	2000-2500 gr	30	13.1
	2500-4000 gr	196	85.2
	>4000 gr	4	1.7
Breastfeeding	None	9	3.91
	0-3 month	5	2.17
	3-6 month	6	2.61
	6-12 month	62	26.96
	12-24 month	148	64.35
Switching to supplementary food	0-3 month first 3 months	1	0.43
	3-6 month	40	17.40
	6.month	189	82.17
Use of packaged products in supplementary food	None	101	43.91
	Rare	42	18.26
	Sometimes	43	18.70
	Usually	44	19.13
Current use of packaged food	None	26	11.30
	Rare	62	26.96
	Sometimes	108	46.96
	Usually	34	14.78
Prophylaxis of vitamin D	Yes	216	93.9
	No	14	6.1
Prophylaxis of iron	Yes	209	90.9
	No	21	9.1
DDST-II Test	Normal	155	67.4
	Abnormal	42	18.2
	Uncertain	33	14.6

Min: minimum, Max: Maximum

45), 25.7% were employed, and 26.1% had a university degree. The mean age of their fathers was 34.96±5.88 years (min 21, max 59), with 97.4% employed and 27.8% graduated from university. Families' incomes ranged from 6.1% low to 48.7% medium and 45.2% high. The majority of parents (98.7%) married, with 1.3% divorcing. The proportion of parents who were related was 12.2%. Pregnancies were planned 85.7% of the time, and unplanned 14.3%. The majority of the mothers' pregnancies (98.3%) were monitored.

The most popular screen type was television (53.7%), followed by phones (34.7%) and computers/iPads (11.6%). The reasons given by parents for their children's screen exposure were 55.5% distraction, 30.5% feeding, and 7% sleeping. Children spent less than an hour on the screen 86 (37.7%), 1-3 hours 94 (40.8%), 3-5 hours 39 (16.8%), and more than 5 hours11 (4.7%). Parental control over children's screen time was rated;

Table 2. Screen characteristics of children

		N	%
Screen time	<1 hour	86 (230)	37.7
	1-3 hours	94 (230)	40.8
	3-5 hours	39 (230)	16.8
	>5 hours	11 (230)	4.7
Parent' control >1 hour	Never	68 (144)	47.2
	Usually	59 (144)	40.9
	Always	17 (144)	11.9
Screen types	Television	93 (173)	53.7
	Phone	60 (173)	34.7
	Computer/i-pad	20 (173)	11.6
Reason of screen exposure	Distraction	80 (144)	55.5
	Feeding	44 (144)	30.5
	Before sleeping	10 (144)	7
	Other reasons	10 (144)	7

46.9% never controlled, 41.3% usually controlled, and 11.9% always controlled (Table2).

The DDST-II test of 155 (67.4%) of the children was evaluated as normal, 42 (18.2%) as abnormal, and 33 (14.6%) as

uncertain. The mean age of those whose DDST-II test was abnormal was 46±12.3 months. Children's age, height, and body weight significantly correlated with their DDST-II test results (p<0.001). The incidence of abnormal Denver-I tests increased with increasing height, weight, and age (Table 3).

Table 3. Comparison of DDST-2 test results with children's age, height, body weight

	Normal (mean±SD)	Abnormal (mean±SD)	Uncertain (mean ± SD)	x^2	*p*
Weight (kg)	13.82±3.9	17.54±5	14.19±3.2	22.602	**<0.001***
Length (cm)	91±14	103±10.3	93±10.8	26.686	**<0.001***
Age (months)	32±17	46±12.3	34±12.3	23.003	**<0.001***

*Kruskal Wallis, SD: Standart derivation

There were no statistically significant relationships discovered between the children's birth week, type of birth, birth weight, gender, and DDST-II test results (p>0.05). There were no statistically significant relationships found between the children's parents' ages, educational status, employment, family income, parents' marriage status, or kinship status and DDST-II test results (p>0.05). There were no statistically significant associations found between the mother's age at birth, number of pregnancies, pregnancy planning status, pregnancy monitoring status, and smoking during pregnancy and Denver-II test results (p>0.05). There was no statistically significant relationship discovered between children's exclusive breastfeeding in the first 6 months, duration of exclusive breastfeeding, time to transition to complementary food, and use of packaged products in complementary food and DDST-II test results. There was no statistically significant relationship between the baby's iron and vitamin D prophylaxis intake and the DDST-II test results (p>0.05). Children exposed to screens for over an hour had abnormal DDST-II test results compared to those exposed for less than an hour (p<0.001). Children exposed to screens for more than 3 hours had a higher rate of abnormal DDST-II test results than those exposed for 1-3 hours (p < 0.001) (Table 4). DDST-II test results were significantly associated with parental control over screen exposure (p<0.001). The rate of abnormal DDST-II results was higher in children who had no parental control over screen time (Table 4).

DISCUSSION

Our research suggests that excessive screen time is the first factor in DDs, with higher screen time at 6-60 months leading to poorer performance on developmental screening tests and lower scores. Early detection, rehabilitation, and identification of etiological factors for children at risk of DD is critical in developing countries, where over 200 million children are unable to fully develop.[18] In the current study, we investigated the child and parents sociodemographic factors thought to contribute to early childhood DD, as well as the effect of screen exposure on DD. Screen time exceeding the WHO' guidelines of one hour per day was linked with increased delays in developmental milestone achievement.

While some studies suggest that male gender, maternal age of ≥ 35, low education, consanguineous marriage, low family socioeconomic status, lack of iron supplementation, cesarean section delivery, and birth order increases the risk of DD, others found no correlation.[18]

The results of the DDST-II test did not correlate with the mother's pregnancy or birth history, the parents' sociodemographic traits, or the child's demographic characteristics, exclusive breastfeeding, iron and vitamin D prophylaxis, as reported in the literature.

Screen time for children under five ranged from 0.1 to 5 hours per day and children aged 24- 60 months were watching on average 2 hours per day in recent studies.[11,20] In our study, most of children' 40.8% screen time between 1-3 hours. The amount of screen time in our research was consistent with a recent report. No gender differences in screen time were found concordant with the previous research.[21]

According to studies, screen time can be accessed via computers, television, iPads smartphones, or mobile games. Children under the age of five prefer television over other digital devices, whereas older children prefer computers.[20,22,23] The most common screen type was television in our study. Our participants may have been exposed to television because they were younger and under the age of five.

Parents' perceptions, attitudes, beliefs, and time spent with their children all have a significant impact on their children's screen exposure.[24,25] Children's screen exposure is positively associated with access to gadgets, screen time rules, and parenting skills,

Table 4. Comparison of DDST-2 test results and screen exposure characteristics

	Normal (%)	Abnormal (%)	Uncertain (%)	X'	*p*
Screen exposure >1 hour					
Yes	82 (56.9)	37 (25.7)	25 (17.4)	20.328	**<0.001***
No	73 (84.9)	5 (5.8)	8 (9.3)		
Screen exposure time					
1-3 hours	64 (68.8)	12 (12.9)	17 (18.3)	24.256	**<0.001***
>3 hours	18 (36.0)	25 (50.0)	7 (14.0)		
Parent screen time control					
Always	14 (82.4)	2 (11.8)	1 (5.9)	17.374	**0.002***
Usually	39 (66.1)	8 (13.6)	12 (20.3)		
Never	29 (43.3)	27 (40.3)	11 (16.4)		

*Chi-square test

whereas parental confidence and good care type have a negative impact on screen time.[23,27] Parental consideration can trigger conflicts, and children may mimic screen-time habits. As previously observed, children with no parental control over screen exposure had a higher rate of screen time and worse results in Denver-II test in our research.[22,26] At this point, we saw how important parental screen time control is in child DD.

Insufficient screen exposure and content has been linked to delayed motor, cognitive, and language development in children.[10-17,27] Uncontrolled viewing of indiscriminate content from the media, especially unsupervised material, has the potential to negatively impact a child's behavior.[28] As children get older, they spend more time on screens. Screen time is positively correlated with age, sedentary choices, poor sleep, interrupted sleep at night, and delayed cognitive achievements, and hyperactivity.[26-30] The long-term impacts of screen exposure are anticipated to result in poorer behavioral results in children as they getting older. Children who use digital media excessively are less likely to engage in healthy activities.[29] This can result in unfavorable behavioral effects such as aggression and antisocial behaviors, reduced success in school and an increased prevalence of overweight, obesity, and noncommunicable diseases.[28] Screen time may impair developmental outcomes by replacing possibilities for learning such as learning a language and motor skills. Our study discovered a strong connection between increased screen time and poor developmental measures throughout various fields, supporting previous research.[11]

Limitations

Our study had the following limitations: it was a single-center study and DDST-II could be reapplied at later ages, and a correlation with increased duration of screen exposure could be observed over time. Multicenter studies with a greater number of patients and longer follow-up times are required.

CONCLUSION

The study reveals a high prevalence of excessive screen time in under-five children and a direct link to poor DDST-II performance. Understanding screen-based tasks, home-based regulations, and parental choices are crucial for screen time reduction. Pediatricians should investigate parents' screen time history and develop guidelines for permissible limits and interventions.

ETHICAL DECLARATIONS

Ethics Committee Approval

The study was carried out with the permission of the Dışkapı Yıldırım Beyazıt Training and Research Hospital' Ethics Committee, (Date 25.11.2019 Decision No:76/03).

Informed Consent

All patients signed and free and informed consent form.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

The authors declared that this study has received no financial support.

Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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